

## Written Reply

To Mr. Seiji HAMADA, Examiner at the Patent Office

### 1. Identification of the International Application

PCT/JP2004/005125

### 2. Applicant

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JAPAN  
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### 3. Attorney

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4. Date of Notification: 06.07.2004 (Mailing date)

### 5. Contents of this Argument

We have received the opinion in accordance with the regulation of Article 13 regarding international applications under Patent Cooperation Treaty (PCT Rule 66), and would like to respond with the following argument.

(1) In the present invention, claims 1, 7 and 9 are amended and claims 4, 8 and 10 are cancelled as shown in the attached Written Amendment.

The amendments in the amended claims 1, 7 and 9 are supported by the original claim 4 and the original specification page 6, lines 17-23 (in English translation, page 6, lines 21-25) and FIG. 2A.

(2) The Written Opinion indicates that claims 1-13 lack inventive step. (Features of the present invention)

i. According to the present invention, in a solar cell comprising a p-type semiconductor layer having bandgaps at the both ends being at least

1.08 eV or 1.17 eV, the p-type semiconductor layer comprises a first region at a n-type semiconductor layer side and a second region at a first electrode layer side, the bandgap of the p-type semiconductor layer increases in the first region at a predetermined increase rate from the n-type semiconductor layer side to the first electrode layer side, and increases in the second region at an increase rate smaller than the increase rate in the first region from the n-type semiconductor layer side to the first electrode layer side.

ii. According to the above-mentioned configuration, a remarkable effect of obtaining a solar cell with further excellent characteristics such as a conversion efficiency is realized.

iii. It has been known in conventional techniques that, in a so-called narrow-band solar cell having a p-type semiconductor layer whose bandgap is about 1.17 eV or less, a maximum conversion efficiency can be obtained due to a so-called double graded bandgap structure, that is, the bandgap of the p-type semiconductor layer increases after a temporary decrease from a n-type semiconductor layer side to a first electrode layer side. And this has been considered to occur in a solar cell with a larger bandgap.

However, after keen study, the present inventors found that this knowledge cannot be applied to a solar cell comprising a p-type semiconductor layer whose bandgaps at the both ends are at least 1.08 eV and 1.17 eV, and that the bandgap structure of the present invention, that is, “the p-type semiconductor layer comprises a first region at the n-type semiconductor layer side and a second region at the first electrode layer side, the bandgap of the p-type semiconductor layer increases in the first region at a predetermined rate from the n-type semiconductor layer side to the first electrode side, and increases in the second region at a rate smaller than the increase rate in the first region from the n-type semiconductor layer side to the first electrode side” serves more to improve the efficiency of the solar cell than the double graded structure will do. The present invention is based on the finding.

(Comparison to cited documents)

i. D1 describes a single graded structure (FIG. 8) where a bandgap of a p-type semiconductor layer is from 0.95 to 1.17 eV and the bandgap of the p-type semiconductor layer increases at a predetermined change rate, and a double graded structure (FIG. 10) where the bandgap of the p-type semiconductor layer once decreases at a predetermined change rate and then increases again.

However, D1 is silent about the bandgap structure according to the present invention, namely a bandgap “that increases at a predetermined increase rate in a first region and increases in a second region at an increase rate smaller than the increase rate in the first region from a n-type semiconductor layer side to a first electrode layer side”, and the effects.

ii. D2 describes only a solar cell where a bandgap of the p-type semiconductor layer is from 1.04 to 1.68 eV, but D2 is silent about a structure and effects of the bandgap of the p-type semiconductor layer.

iii. D3 describes a double graded structure (FIG. 6) where a bandgap of a p-type semiconductor layer decreases once at a predetermined change rate and then increases again.

However, the document is silent about the configuration and effect of the present invention.

iv. D4 describes a double graded structure (FIG. 4) where a bandgap of the p-type semiconductor layer decreases once at a predetermined change rate and then increases again.

However, the document is silent about the configuration and effect of the present invention.

v. As mentioned above, D1-D4 are silent about the configuration of the present invention for a solar cell where a bandgap of the p-type semiconductor layer is at least 1.08 eV and 1.17 eV, or the cited documents are silent about the effects. Furthermore, in light of conventional knowledge that a double graded structure realizes an optimum conversion efficiency, we believe that it would not be obvious for any persons skilled in the art to obtain the configuration of the present invention based on D1-D4.

Since the present invention is not described or suggested by any of the cited documents and since remarkable effects can be realized due to the difference, we believe that the present invention has inventive step.

## 6. List of attached documents

- 1) Written Amendment (1 set)

## PATENT COOPERATION TREATY

PCT

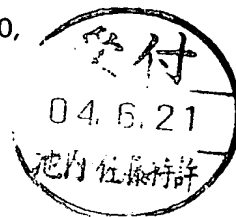
NOTIFICATION CONCERNING  
SUBMISSION OR TRANSMITTAL  
OF PRIORITY DOCUMENT

(PCT Administrative Instructions, Section 411)

From the INTERNATIONAL BUREAU

To:

IKEUCHI SATO & PARTNER PATENT  
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Date of mailing (day/month/year) 14 June 2004 (14.06.2004)	
Applicant's or agent's file reference H2020-01	<b>IMPORTANT NOTIFICATION</b>
International application No. PCT/JP2004/005125	International filing date (day/month/year) 09 April 2004 (09.04.2004)
International publication date (day/month/year) Not yet published	Priority date (day/month/year) 09 April 2003 (09.04.2003)
Applicant MATSUSHITA ELECTRIC INDUSTRIAL CO. LTD. et al	

- By means of this Form, which replaces any previously issued notification concerning submission or transmittal of priority documents, the applicant is hereby notified of the date of receipt by the International Bureau of the priority document(s) relating to all earlier application(s) whose priority is claimed. Unless otherwise indicated by the letters "NR", in the right-hand column or by an asterisk appearing next to a date of receipt, the priority document concerned was submitted or transmitted to the International Bureau in compliance with Rule 17.1(a) or (b).
- (If applicable) The letters "NR" appearing in the right-hand column denote a **priority document which, on the date of mailing of this Form, had not yet been received by the International Bureau** under Rule 17.1(a) or (b). Where, under Rule 17.1(a), the priority document must be submitted by the applicant to the receiving Office or the International Bureau, but the applicant fails to submit the priority document within the applicable time limit under that Rule, **the attention of the applicant is directed** to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.
- (If applicable) An asterisk (\*) appearing next to a date of receipt, in the right-hand column, denotes a **priority document submitted or transmitted to the International Bureau but not in compliance with Rule 17.1(a) or (b)** (the priority document was received after the time limit prescribed in Rule 17.1(a) or the request to prepare and transmit the priority document was submitted to the receiving Office after the applicable time limit under Rule 17.1(b)). Even though the priority document was not furnished in compliance with Rule 17.1(a) or (b), the International Bureau will nevertheless transmit a copy of the document to the designated Offices, for their consideration. In case such a copy is not accepted by the designated Office as priority document, Rule 17.1(c) provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.

<u>Priority date</u>	<u>Priority application No.</u>	<u>Country or regional Office or PCT receiving Office</u>	<u>Date of receipt of priority document</u>
09 April 2003 (09.04.2003)	2003-105752	JP	03 June 2004 (03.06.2004)

The International Bureau of WIPO  
34, chemin des Colombettes  
1211 Geneva 20, Switzerland

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From the INTERNATIONAL BUREAU

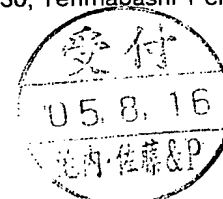
**PCT**

SECOND AND SUPPLEMENTARY NOTICE  
INFORMING THE APPLICANT OF THE  
COMMUNICATION OF THE INTERNATIONAL  
APPLICATION (TO DESIGNATED OFFICES  
WHICH APPLY THE 30 MONTH TIME  
LIMIT UNDER ARTICLE 22(1))

(PCT Rule 47.1(c))

To:

IKEUCHI SATO & PARTNER PATENT ATTORNEYS  
26th Floor, OAP TOWER, 8-30, Tenmabashi 1-chome,  
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Date of mailing (day/month/year) 11 August 2005 (11.08.2005)		
Applicant's or agent's file reference H2020-01		<b>IMPORTANT NOTICE</b>
International application No. PCT/JP2004/005125	International filing date (day/month/year) 09 April 2004 (09.04.2004)	Priority date (day/month/year) 09 April 2003 (09.04.2003)
Applicant MATSUSHITA ELECTRIC INDUSTRIAL CO., LTD. et al		

- ATTENTION:** For any designated Office(s), for which the time limit under Article 22(1), as in force from 1 April 2002 (30 months from the priority date), **does not apply**, please see Form PCT/IB/308(First Notice) issued previously.
- Notice is hereby given that the following designated Office(s), for which the time limit under Article 22(1), as in force from 1 April 2002, **does apply**, has/have requested that the communication of the international application, as provided for in Article 20, be effected under Rule 93bis.1. The International Bureau has effected that communication on the date indicated below:  
21 October 2004 (21.10.2004)

AU, AZ, BY, CN, CO, DZ, EP, HU, KG, KP, KR, MD, MK, MZ, NA, RU, SY, TM, US

In accordance with Rule 47.1(c-bis)(i), those Offices will accept the present notice as conclusive evidence that the communication of the international application has duly taken place on the date of mailing indicated above and no copy of the international application is required to be furnished by the applicant to the designated Office(s).

- The following designated Offices, for which the time limit under Article 22(1), as in force from 1 April 2002, **does apply**, have not requested, as at the time of mailing of the present notice, that the communication of the international application be effected under Rule 93bis.1:

AE, AG, AL, AM, AP, AT, BA, BB, BG, BR, BW, BZ, CA, CR, CU, CZ, DE, DK, DM, EA, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, ID, IL, IN, IS, JP, KE, KZ, LC, LK, LR, LS, LT, LV, MA, MG, MN, MW, MX, NI, NO, NZ, OA, OM, PG, PH, PL, PT, RO, SC, SD, SG, SK, SL, TJ, TN, TR, TT, UA, UZ, VC, VN, YU, ZA, ZW

In accordance with Rule 47.1(c-bis)(ii), those Offices accept the present notice as conclusive evidence that the Contracting State for which that Office acts as a designated Office does not require the furnishing, under Article 22, by the applicant of a copy of the international application.

#### 4. TIME LIMITS for entry into the national phase

For the designated or elected Office(s) listed above, the applicable time limit for entering the national phase will, **subject to what is said in the following paragraph**, be **30 MONTHS** from the priority date.

In practice, **time limits other than the 30-month time limit** will continue to apply, for various periods of time, in respect of certain of the designated or elected Office(s) listed above. For **regular updates on the applicable time limits** (30 or 31 months, or other time limit), Office by Office, refer to the *PCT Gazette*, the *PCT Newsletter* and the *PCT Applicant's Guide*, Volume II, National Chapters, all available from WIPO's Internet site, at <http://www.wipo.int/pct/en/index.html>.

It is the applicant's **sole responsibility** to monitor all these time limits.

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland	Authorized officer  Yoshiko Kuwahara
Facsimile No.+41 22 740 14 35	Facsimile No.+41 22 338 90 90

特 許 協 力 条 約

PCT

特許性に関する国際予備報告（特許協力条約第二章）

（法第12条、法施行規則第56条）  
〔PCT36条及びPCT規則70〕



出願人又は代理人 の書類記号 H2020-01	今後の手続きについては、様式PCT/ IPEA/ 416を参照すること。	
国際出願番号 PCT/JP2004/005125	国際出願日 (日.月.年) 09.04.2004	優先日 (日.月.年) 09.04.2003
国際特許分類 (IPC) Int. Cl <sup>7</sup> H01L31/072, H01L31/032		
出願人 (氏名又は名称) 松下電器産業株式会社		

<p>1. この報告書は、PCT35条に基づきこの国際予備審査機関で作成された国際予備審査報告である。 法施行規則第57条（PCT36条）の規定に従い送付する。</p> <p>2. この国際予備審査報告は、この表紙を含めて全部で <u>3</u> ページからなる。</p> <p>3. この報告には次の附属物件も添付されている。</p> <p>a <input checked="" type="checkbox"/> 附属書類は全部で <u>3</u> ページである。</p> <p><input checked="" type="checkbox"/> 補正されて、この報告の基礎とされた及び／又はこの国際予備審査機関が認めた訂正を含む明細書、請求の範囲及び／又は図面の用紙（PCT規則70.16及び実施細則第607号参照）</p> <p><input type="checkbox"/> 第I欄4. 及び補充欄に示したように、出願時における国際出願の開示の範囲を超えた補正を含むものとこの国際予備審査機関が認定した差替え用紙</p> <p>b <input type="checkbox"/> 電子媒体は全部で _____（電子媒体の種類、数を示す）。 配列表に関する補充欄に示すように、コンピュータ読み取り可能な形式による配列表又は配列表に関連するテーブルを含む。（実施細則第802号参照）</p>	
<p>4. この国際予備審査報告は、次の内容を含む。</p> <p><input checked="" type="checkbox"/> 第I欄 国際予備審査報告の基礎</p> <p><input type="checkbox"/> 第II欄 優先権</p> <p><input type="checkbox"/> 第III欄 新規性、進歩性又は産業上の利用可能性についての国際予備審査報告の不作成</p> <p><input type="checkbox"/> 第IV欄 発明の単一性の欠如</p> <p><input checked="" type="checkbox"/> 第V欄 PCT35条(2)に規定する新規性、進歩性又は産業上の利用可能性についての見解、それを裏付けるための文献及び説明</p> <p><input type="checkbox"/> 第VI欄 ある種の引用文献</p> <p><input type="checkbox"/> 第VII欄 国際出願の不備</p> <p><input type="checkbox"/> 第VIII欄 国際出願に対する意見</p>	

国際予備審査の請求書を受理した日 02.02.2005	国際予備審査報告を作成した日 23.03.2005	
名称及びあて先 日本国特許庁 (IPEA/JP) 郵便番号100-8915 東京都千代田区霞が関三丁目4番3号	特許庁審査官（権限のある職員） 浜田 聖司	2K 9207
電話番号 03-3581-1101 内線 3253		

## 第 I 欄 報告の基礎

1. この国際予備審査報告は、下記に示す場合を除くほか、国際出願の言語を基礎とした。

☐ この報告は、\_\_\_\_\_ 語による翻訳文を基礎とした。

それは、次の目的で提出された翻訳文の言語である。

☐ PCT規則12.3及び23.1(b)にいう国際調査

☐ PCT規則12.4にいう国際公開

☐ PCT規則55.2又は55.3にいう国際予備審査

2. この報告は下記の出願書類を基礎とした。(法第6条(PCT14条)の規定に基づく命令に応答するために提出された差替え用紙は、この報告において「出願時」とし、この報告に添付していない。)

☐ 出願時の国際出願書類

☒ 明細書

第 1-38 ページ、出願時に提出されたもの

第 \_\_\_\_\_ ページ\*、 \_\_\_\_\_ 付けて国際予備審査機関が受理したもの

第 \_\_\_\_\_ ページ\*、 \_\_\_\_\_ 付けて国際予備審査機関が受理したもの

☒ 請求の範囲

第 2-3, 5-6, 11-13 項、出願時に提出されたもの

第 \_\_\_\_\_ 項\*、PCT19条の規定に基づき補正されたもの

第 1, 7, 9 項\*、02.02.2005 付けて国際予備審査機関が受理したもの

第 \_\_\_\_\_ 項\*、 \_\_\_\_\_ 付けて国際予備審査機関が受理したもの

☒ 図面

第 1-5 ページ/図、出願時に提出されたもの

第 \_\_\_\_\_ ページ/図\*、 \_\_\_\_\_ 付けて国際予備審査機関が受理したもの

第 \_\_\_\_\_ ページ/図\*、 \_\_\_\_\_ 付けて国際予備審査機関が受理したもの

☐ 配列表又は関連するテーブル

配列表に関する補充欄を参照すること。

3. ☒ 補正により、下記の書類が削除された。

☐ 明細書 第 \_\_\_\_\_ ページ

☒ 請求の範囲 第 4, 8, 10 項

☐ 図面 第 \_\_\_\_\_ ページ/図

☐ 配列表(具体的に記載すること) \_\_\_\_\_

☐ 配列表に関連するテーブル(具体的に記載すること) \_\_\_\_\_

4. ☐ この報告は、補充欄に示したように、この報告に添付されかつ以下に示した補正が出願時における開示の範囲を超えてされたものと認められるので、その補正がされなかったものとして作成した。(PCT規則70.2(c))

☐ 明細書 第 \_\_\_\_\_ ページ

☐ 請求の範囲 第 \_\_\_\_\_ 項

☐ 図面 第 \_\_\_\_\_ ページ/図

☐ 配列表(具体的に記載すること) \_\_\_\_\_

☐ 配列表に関連するテーブル(具体的に記載すること) \_\_\_\_\_

\* 4. に該当する場合、その用紙に“superseded”と記入されることがある。

第V欄 新規性、進歩性又は産業上の利用可能性についての法第12条（PCT35条(2)）に定める見解、それを裏付ける文献及び説明

1. 見解

新規性 (N)	請求の範囲	1-3, 5-7, 9, 11-13	有 無
	請求の範囲		
進歩性 (IS)	請求の範囲	1-3, 5-7, 9, 11-13	有 無
	請求の範囲		
産業上の利用可能性 (IA)	請求の範囲	1-3, 5-7, 9, 11-13	有 無
	請求の範囲		

2. 文献及び説明 (PCT規則70.7)

- 文献1 : M. Contreras et al., "High Efficiency Cu(In,Ga)Se<sub>2</sub>-Based Solar Cells: Processing of Novel Absorber Structures", First WCPEC (World Conference on Photovoltaic Energy Conversion); Dec. 5-9, 1994; Hawaii, pp.68-75
- 文献2 : K. Kushiya et al., "Development of Polycrystalline CuIn<sub>x</sub>Ga<sub>1-x</sub>Se<sub>2</sub> Thin-Film Solar Cells with Band Gap of 1.3 to 1.5 eV", Japanese Journal of Applied Physics, Part 1, No.12A, Vol.33 (1994) pp.6599-6604
- 文献3 : T. Negami et al., "Production technology for CIGS thin film solar cells", Thin Solid Films, 403-404 (2002) pp.197-203
- 文献4 : T. Dullweber et al., "Study of the effect of gallium grading in Cu(In,Ga)Se<sub>2</sub>", Thin Solid Films, 361-362 (2000) pp.478-481
- 文献5 : J P 9-213977 A (松下電器産業株式会社) 1997.08.15
- 文献6 : J P 11-274526 A (矢崎総業株式会社) 1999.10.08
- 文献7 : A. Dhingra et al., "Computer Simulation and Modeling of Graded Bandgap CuInSe<sub>2</sub>/CdS Based Solar Cells", IEEE Transactions on Electron Devices, Vol.43, No.4, 1996, pp.613-621

国際調査報告で提示された上記文献1-7には、CIS (CIGS) 層を請求の範囲1に規定されるようなバンドギャップで構成した例は開示されていない。

したがって、請求の範囲1-3, 5-7, 9, 11-13は、上記文献に対して新規性および進歩性を有するものと考えられる。